GCMS/MONTGOLFIERE MICROMISSION TO MARS

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ABSTRACT

A Micromission concept is presently under study by JPL, GSFC, and Honeybee Robotics, in which a surface package including a miniaturized GCMS and one meter drill, would be delivered to the surface by a solar heated hot air balloon, known as a solar Montgolfiere. The balloon system would be deployed about 8 km above the surface of Mars, where it would rapidly fill with Martian atmosphere and be heated quickly by the sun. The combined buoyancy and parachuting effects of the solar balloon result in a surface package/air bag impact of about 9 m/sec, or less than half the impact velocity of Pathfinder, and without the heavy, expensive Pathfinder retrorocket landing system. After delivery of the GCMS package to the surface, one option is to allow the balloon to ascend, using solar heating, to as high as about 7 km altitude, with imaging, magnetic, and atmospheric data being taken by a small science gondola for the remainder of the daylight hours. This would allow the balloon to perform science measurements over a path of many hundreds of kilometers as it travels downwind from the GCMS landing site. **Total atmospheric entry mass of this mission, including 30% payload margin, is estimated to be 40 to 45 kg (with or without post-landing balloon mission), and it can fit as an Ariane 5 piggyback payload for an '05 or '07 launch to Mars.**

The GCMS would obtain samples directly from the atmosphere at the surface and also from gases evolved from solid phase material collected from as deep as one meter below the surface with a Sample Acquisition and Transport Mechanism (SATM) drill. **Compared to the Viking GCMS, the experiment envisioned herein would obtain samples from a much greater depth below the surface, and would search for organic molecules trapped in ancient stratified layers well below the oxidized surface.** In addition, the experiment would be designed to measure trace atmospheric constituents and obtain precision isotope measurements of atmospheric noble gases and elements.

The solar-powered Montgolfiere balloon system has recently been demonstrated in the Earth's stratosphere at 33 km altitude (0.008 mbar) as deployed from an entry-shaped vehicle while falling at 50 m/sec on a parachute. The lightweight Montgolfiere balloon requires about 2 minutes to fill and one additional minute to attain fully heated buoyancy. The landed GCMS/drill package (~14 kg plus 4 kg of airbags), would achieve all of its primary scientific objectives in the first several hours on the surface. The maximum lifetime of the lander experiments would not exceed several days, with the exception of an imaging and weather station, which would be powered for approximately one month. The GCMS would be a simplified version of the instrument developed for the Cassini Huygens Probe of Titan's atmosphere, and would achieve substantial improvements in sensitivity and precision in isotope measurements compared to the Viking GCMS. The drill would be similar to that developed for the Champollion comet lander experiment to deliver comet nucleus material to a microscope camera, and it has undergone testing on both loose and very hard materials.